Method and Device for Nozzle-Jetting of Oxygen with Radial Catalyst Flow

The invention pertains a method and device for nozzle-jetting of oxygen in a synthesis reactor, for example, for oxi-dehydration, with mainly radial flow of the gas mixture through a catalyst packing.

There is a series of catalytic methods, in which oxygen is additionally added to the gas to be treated in a reactor, say in the so-called oxi-dehydration of propane or butane, whereby the oxygen in the oxi-dehydration reactors is mixed to the gas flowing in before entry into the catalyser. It has been seen that, especially the irregular mixing through the gas flowing into the catalyser with oxygen, leads to unsatisfactory results, whether in the form of soot formation above the catalyser or insufficient material yield, say the yield of propylene.

This is where the invention comes in, with the task of improving the entry and mixing of oxygen before entering into the catalyser, particularly for oxi-dehydration method.

With the help of the method already described above, this task as per the invention is fulfilled, in that the oxygen is added to a ring distributor system in pure form, as air or mixed with inert gas or in water vapour, and is nozzle-jetted on to the catalyser surface at an angle to the vertical through multiple exit openings in the ring distributor.

It has been seen that, through this method a thorough mixing can be attained in a very short time of < 100 msec. so that the reaction time in zones with over-stoichiometric oxygen concentration and the non-catalytic reaction get minimized. As the mixing takes place in open air and the oxygen-rich mixing has no contact with walls or with the catalyser, the damage of materials/substances due to the jetted-in oxygen get minimized.

Extensions of the invention can be obtained from the sub-claims.

Depending on the design of the reactor, it could be purposeful to carry out the nozzle jetting of oxygen from a cylindrical plane in the interior of the catalyser bed in the direction on to the reactor wall. The method as per the invention could thereby foresee the nozzle jetting with the help of several parallel pipes with exit openings forming a cylindrical inner axial plane.

A special extension of the invention consists of the fact that the nozzle jetting of the oxygen in a cylindrical axial plane take place approx. 50 to 300 mm before the cylindrical inner wall of the catalyser bed, which ensure an oxygen dwelling time of $\leq$ 1 sec. in the chamber before the catalyser bed. The dwelling time could be 100 msec, preferably $\leq$ 15 msec.

As a solution for this task, the invention foresees a device, which has the special feature of a ring distributor with several pipes with exit openings forming an inner cylindrical plane before the cylindrical inner surface of the catalyser bed, whereby the exit openings are designed for releasing the oxygen at an angle to the perpendicular, on to the catalyser cylindrical surface.

In an advantageous extension it could be foreseen, that the gas exit openings are aligned in alternating sequence to adjacent exit openings of an adjacent ring pipe, whereby adjacent gas exit openings could have different flow exit directions.

A further advantageous extension of the invention consists of the fact, that the gas exit openings are designed as holes or nozzles.

A few literature documents are referred to at this point, to illustrate the state-of-the-art technology. Thus the document DE-43 33 372-A, which publishes a production method of olefins from gas mixture containing methane; the document DE-32 40 089-A or US-5 935 489, which indicates a method and a device for synthesis gas production with partial oxidation, or the US-patent document 2 518 583, 2 809 981 or 2 954 281. From the

document US-2 584 391, one can take the nozzle jetting of a reactant in directions deviating from the perpendicular, in order to achieve more effective contact between solid and gas particles in a fluidised bed of a reactor. For further state-of-the-art technology, one can also mention the documents US-2 632 692, US-3 208 833, GB-2 065 492-A or EP-0 364 664-B.

Further features, details and advantages of the invention can be obtained on the basis of the following descriptions and the drawings. The following are shown:

Fig.1 A highly simplified depiction of the device as per the invention;
Fig.2 A detailed enlargement in the region of the catalyser with indicated gas flow; and
Fig.3 A cross-section of the reactor in the region of the catalyser.

The oxi-reactor schematically shown in section in fig. 1 and generally denoted by 1 has a gas inlet pipe 2, which centrically goes through a catalyser 3 up to an upper covering 10, whereby in the upper region of the reactor 1 a gas dome 4 is designed. In the gas dome 4 there is a ring distributor 5 for oxygen in pure form, as air or mixed with inert gas or water vapour, whereby this ring pipe 5 is equipped with several pipes 7 pointing perpendicularly downwards and provided with exit openings 6. The exit openings 6 are arranged in such a way, that the respective gas jet gets directed on to the cylindrical inner catalyser surface at an angle to the perpendicular, which is depicted in figures 2 and 3 by small arrows.

In fig. 1, the O_2- or gas entry into the ring distributor 5 is indicated by the arrow 8, the gas exit from the reactor is indicated by the arrow 9.

The flow path of the gas flowing through the reactor with the additional oxygen is indicated in fig. 2 by a dashed arrow 11.

Obviously the described design example of the invention can be changed in several aspects without deviating from the basic idea; especially the angle of impact can be selected also differently than the one shown, depending on the model of the reactor. In particular cases of application, it could be useful to conceive the flow of the catalyser packing from outside to inside. This is however not always required in oxi-reactions due to increase in volume, but could nevertheless be of advantage in some cases (high volume velocities) due to by-product formation or similar occurrences.